TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION DIVISION OF UNDERGROUND STORAGE TANKS

ENVIRONMENTAL ASSESSMENT GUIDELINES

August 1996

DISCLAIMER

This document has been prepared to provide guidance and standardized procedures for conducting petroleum site investigations. These guidelines shall be followed unless prohibited by site specific conditions or other applicable statutes, rules or regulations. If a variance is necessary, the Division shall be contacted for prior approval. All assessment activities shall be reasonable, proper and justifiable in order to receive reimbursement from the Petroleum Underground Storage Tank Fund. All environmental assessment activities and evaluation of the subsurface investigation shall be directed by a registered professional geologist under the Tennessee Geologist Act *(T.C.A. §62-36-101 et seq.)*, or registered professional engineer under the Tennessee Architects, Engineers, Landscape Architects, and Interior Designers Law and Rules *(T.C.A. §62-2-101 et seq.)*.

It is understood that the procedures outlined in this document cannot cover every eventuality; however, these guidelines shall be used in all cases where appropriate. If site specific conditions warrant variations from these procedures, the local field office shall be informed prior to the implementation of these variations and approval shall be obtained. All variations from these procedures shall be noted in the applicable report.

When performing all assessment activities within these guidelines, all relevant data shall be collected and reported in the appropriate report format.-

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FORMS

I. SOIL INVESTIGATION PROCEDURES

Prior to installing any soil borings, all aboveground and underground utilities, storage tanks and lines shall be identified to prevent accidental damage.

A. Number and Location of Soil Borings

During the investigation, soil samples shall be collected and analyzed from borings placed in the following locations:

1. The first boring (B-1/MW-1) shall be placed in the upgradient direction of the release.

2. The second and third borings (B-2/MW-2, B-3/MW-3) shall be placed in the downgradient direction of the release.

3. The fourth boring (B-4/MW-4) shall be placed as close as possible to the location of the release. If the specific location of the release is unknown, then this boring shall be located where the site specific data suggests the highest levels of contamination exist.

B. Boring Methods

All soil borings shall be advanced utilizing a hollow-stem auger or a direct push instrument. A hand auger or power auger may be utilized if one of the following conditions exist:

1. The area to be investigated is inaccessible to drill rigs;

2. The sampling point is at a shallow depth and therefore appropriate for the technique; or,

3. The sampling point is near utilities, product lines, tanks or buried structures and extreme care must be taken to prevent damage.

C. Procedures for Sample Collection

1. Equipment and Collection

a. Surface samples shall be collected using a new, disposable scoop or properly decontaminated stainless steel scoop.

b. Samples from hand augers and power augers shall be allowed only if discrete samples can be obtained utilizing a properly decontaminated auger bucket, split spoon, or shelby tube. The sampling of auger cuttings is not acceptable.

c. Samples from borings advanced by a drill rig shall be collected utilizing properly decontaminated split spoon samplers. Soil samples shall be collected continuously for the first twenty (20) feet of a boring and at

intervals not to exceed five (5) feet for the remainder of the boring. A two (2) foot or longer split spoon sampler shall be used.

d. When site conditions are suitable, the use of a direct push or hydraulic push sampling method (i.e. Geoprobe, Cone penetrometer, etc.) may be utilized. When using the direct push sampling method, all applicable sections of this guidance document shall be followed.

2. Procedure for Selection of Soil Samples

a. Petroleum Samples

Upon opening the split spoon, the sample shall be split in half lengthwise. One side of the sample shall be immediately placed into a laboratory prepared jar in a manner that eliminates headspace. The jar shall be properly labeled and stored at $4^{o}C$ or less. All samples shall be maintained at $4^{o}C$ until they are delivered to a Division approved laboratory. Once the potential laboratory sample has been properly stored, the remainder of the soil in the split spoon shall be classified and placed in a sealing plastic bag, leaving some air space. The bag shall be properly labeled and the sample allowed to volatilize for a minimum of fifteen (15) minutes at a minimum of $68^{o}F$. All samples shall be allowed to volatilize for an equal period of time prior to screening. Once the sample has been allowed to volatilize, the headspace shall be sampled with an Organic Vapor Detector (OVD).

The OVD shall be either a photoionization detector or a flame ionization detector. The use of vapor detection tubes or other methods of screening are not acceptable unless approved in advance by the Division. The following criteria shall be used when selecting soil samples for laboratory analyses:

i. If the OVD readings and other field screening techniques (visual or olfactory) indicate that contamination does <u>not</u> exist in the soil at a boring location, then the deepest sample shall be analyzed by the laboratory. The deepest sample shall be defined as that sample collected immediately above the soil/bedrock interface, the water table, or the bottom of the boring, whichever occurs first.

ii. If the OVD readings indicate that contamination does <u>not</u> exist in the soil at a boring location but visible or olfactory observations indicate that the soil is contaminated (e.g. heavy hydrocarbon staining), then the following two (2) samples shall be selected for laboratory analyses:

aa. The sample in which visible or olfactory observations indicated the highest level of contamination; and

bb. The sample collected immediately above the soil/bedrock interface, the water table or the bottom of the boring, whichever occurs first.

If one (1) soil sample meets both of the above listed criteria, then only that sample shall be submitted for laboratory analyses.

iii. If the OVD readings indicate that contamination does exist in the soil at a boring location, then three (3) soil samples selected from the following locations shall be submitted for laboratory analyses:

aa. The sample in which the OVD screening indicated the highest level of contamination;

bb. The deepest sample which the OVD screening indicated is contaminated; and

cc. The sample collected immediately above the soil/bedrock interface, the water table or the bottom of the boring.

If one (1) soil sample meets more than one of the above listed criteria then the sample with the second highest OVD screening shall also be submitted for laboratory analyses.

b. Fractional Organic Carbon Analysis Samples

A soil sample shall be collected from the first boring (B-1) at a depth equal to one foot below the bottom of the tank pit or at the soil/bedrock interface whichever occurs first. The sample shall be placed in a laboratory prepared jar, properly labeled and submitted to a laboratory to determine the Fractional Organic Carbon (f_{oc}) content. The sample used for field screening may be submitted for this purpose.

c. Soil Properties Samples

Two (2) shelby tube soil samples shall be collected in the unsaturated zone, within or below the zone of suspected soil contamination. These samples shall be collected from a boring located immediately adjacent to the fourth boring (B-4) at the following depths:

i. Based upon observed soil characteristics obtained while installing the fourth boring (B-4), the first shelby tube shall be collected at the depth that is anticipated to represent the zone of highest permeability.

ii. The second shelby tube shall be collected immediately above the soil/bedrock interface or the water table, whichever occurs first.

If one (1) soil sample meets both of these criteria, then a second shelby tube sample shall be collected at the depth where the second highest permeability would be expected.

D. Analytical Methods

1. Petroleum Analysis

When analyzing soil samples for volatile organics the approved laboratory shall use Test Methods for Evaluating Solid Waste, SW-846. At a minimum, the following constituents shall be analyzed: benzene, toluene, xylenes, ethylbenzene, MTBE. The purge and trap procedures for the soil samples in Method 5030 shall be followed. The actual constituent analysis using gas chromatography with a photoionization detector shall follow Method 8020. The practical quantitation limit for any individual constituent using this method is 0.002 parts per million for low level soil samples. All results shall be reported in parts per million.

There are three (3) methods of analysis for Total Petroleum Hydrocarbons. The method used depends on the type of petroleum released. A review of the type of petroleum stored at the site shall be performed to determine which analytical method or methods shall be used for TPH analysis. Refer to Table 1 below for assistance:

TABLE 1

TPH SOIL ANALYTICAL METHODS		
Boiling Point	Quantitation Limit	Method
1. Between 70^{O}-180^{O}F (e.g. gasoline)	5 PPM	Gasoline Range Organics (GRO)
2. Between 180^{O}-450^{O}F (e.g. diesel, kerosene)	4 PPM	Diesel Range Organics (DRO)
3. Greater than 450^{O}F (e.g. used oil)	100 PPM	Method 503 E or Method 418.1

If a waste oil UST is in the same tank pit as gasoline and/or diesel UST's, then the appropriate combination of analytical methods shall be required. If samples must be analyzed using both the Gasoline Range Organics Method (GRO) and the Diesel Range Organics Method (DRO), then the results of each analysis shall be summed (GRO + DRO) and reported as Total Petroleum Hydrocarbons TPH.

If the type of hydrocarbon stored is unknown or both gasoline and diesel products were stored, the samples must be analyzed using both the Gasoline Range Organics Method and the Diesel Range Organic Method with the results summed to determine the TPH level.

2. Fractional Organic Carbon Analysis

When determining the Fractional Organic Carbon (f_{oc}) Content of the soil, the laboratory shall use one of the following: the Walkley/Black method, the Llyod Kahn method, or ASTM Method D2974-87 (Nelson & Summers).

3. Soil Properties Analysis

If the visual observations and the OVD screenings indicate that contamination does not exist at the fourth boring (B-4), then the undisturbed soil samples shall be collected without consideration for contamination**,** as described in Section I.C.2.c.

The thin-walled tube sampling method (ASTM Method D1587) shall be utilized to collect the samples. The permeabilities shall be determined utilizing the Triaxial - Cell (Section 2.8) or Pressure-Chamber Permeameter (Section 2.9) Methods as described in Method 9100 of Test Methods for Evaluating Solid Waste, Third Edition (SW-846). Other collection and testing methods may be utilized only if prior approval is received from the Division.

The laboratory should be instructed to select the most permeable section of the samples to be analyzed.

The laboratory shall be directed to determine the following parameters from the sections selected and report them in the given units:

Permeability	cm/sec
Volumetric Air Content	cm^3-air/cm^3-soil
Volumetric Water Content	cm^3-H_2O/cm^3-soil
Total Soil Porosity	cm^3/cm^3-soil
Soil Bulk Density	g-soil/cm^3-soil
Fractional Organic Carbon	g-carbon/g-soil

When reporting these values it should indicate whether the sample came from the vadose zone or the capillary fringe.

The sample with the highest permeability shall be utilized when determining the applicable cleanup levels in Tables 2 and 3 below.

TABLE 2

BENZENE SOIL CLEANUP LEVELS (PPM)			
Soil Permeability	$>10^{-4}$ CM/SEC	10^{-4} TO 10^{-6} CM/SEC	$<10^{-6}$ CM/SEC
Drinking Water	5	25	50
Non-Drinking Water	25	50	100

TABLE 3

TPH SOIL CLEANUP LEVELS (PPM)			
Soil Permeability	$>10^{-4}$ CM/SEC	10^{-4} TO 10^{-6} CM/SEC	$<10^{-6}$ CM/SEC
Drinking Water	100	250	500
Non-Drinking Water	250	500	1000

If a shelby tube sample cannot be obtained because of site specific conditions, then the most stringent soil cleanup levels shall apply based on the ground water classification.

E. Borehole Abandonment

All soil borings that are not converted into ground water monitoring wells shall be filled with grout. The grout shall consist of a mixture of Portland cement and 4%-6% powdered bentonite. A grout density of 13.5 to 14.1 lbs/gal shall be used. The grouting operation shall continue until the grout flowing out of the borehole has a minimum density of 13.5 lbs/gal. If water is present in the boring or the total depth of the borehole is greater than thirty (30) feet, a tremie pipe shall be utilized to place the grout. The upper two (2) feet of the boring does not have to remain filled with grout at completion and may be filled with material that is appropriate for the location.

F. Decontamination Procedures

Drill rigs and other equipment shall be inspected for lubricant or fluid leaks which could be a potential contaminant to soil or ground water. All over-the-hole portions of the drilling equipment shall be steam cleaned prior to use and as necessary between borings. All down hole equipment (i.e. augers, drill rods, tools, etc.) shall be steam cleaned prior to use and between all subsequent boring locations.

All sampling equipment which is not pre-cleaned and disposable (i.e. stainless steel scoops, split spoons, etc.) and all monitoring equipment, shall be properly decontaminated before each use by the following procedure:

1. Cleaned with a laboratory grade detergent wash;

2. Triple rinsed with distilled water; and

3. Allowed to air dry.

II. GROUND WATER INVESTIGATION PROCEDURES

A. Number, Type and Location of Monitoring Wells

A minimum of four (4) single cased or open hole monitoring wells shall be required to begin the ground water investigation. These wells shall be constructed by converting soil borings B-1 through B-4 into monitoring wells.

All single cased or open hole monitoring wells shall be installed to monitor the uppermost water bearing zone.

If site specific conditions indicate that contamination may exist in another aquifer, then double cased monitoring wells may be necessary. The Division shall be contacted and prior approval received before proceeding.

B. Drilling Methods

The following drilling methods are approved by the Division:

1. Hollow Stem Auger
2. Air Rotary(downhole hammer or tri-cone)

The following drilling methods shall be allowed only upon approval by the Division:

1. Mud Rotary
2. Cable Tool
3. Rock Coring
4. Wash Rotary (Tri-Cone)

C. Procedures for Documenting Results of Bedrock Sections

1. Camera Logging Procedures

Approval shall be received from the Division prior to camera logging any bedrock wells. Approval shall be granted on a well by well basis. All bedrock wells to be camera logged shall be properly developed prior to logging. Development shall consist of purging the well with a pump to remove particulate matter. The pump shall be raised and lowered throughout the water column during purging operations. A minimum of three (3) well volumes shall be purged from the well and the well shall remain undisturbed for a minimum of twenty four (24) hours prior to logging.

All video tapes produced shall be labeled with the following information: facility name, facility ID, monitoring well number, date, time, logging company name and name of professional in charge. All logs shall have a depth indicator visible on the video image. A copy of each log shall be submitted with the EAR.

2. Rock Coring Procedures

Approval shall be received from the Division prior to rock coring any bedrock wells. Approval shall be granted on a well by well basis. The core shall be logged and photographed.

D. Single and Double Cased Monitoring Well Installation Procedures

The procedures below shall be followed when installing a single or double cased monitoring well.

1. Casing and Screen Type

a. Single Cased

The casing and screen shall be constructed of two (2) inch I.D., pre-cleaned, flush threaded, Schedule 40 PVC. The screen shall have 0.01 inch factory milled slots. The well screen shall be terminated with a threaded end cap and the casing shall be terminated with a locking, watertight cap.

b. Double Cased

The outer casing shall be decontaminated black steel. If site specific conditions and drilling methods are compatible (i.e. hollow stem auger drilling), schedule 80 PVC may be used in lieu of black steel with prior approval by the Division. The inner casing and screen shall be constructed of pre-cleaned, flush threaded, Schedule 40 PVC. The screen shall have 0.01 inch factory milled slots. The screened section shall be terminated with a threaded end cap and the casing shall be terminated with a locking, watertight cap.

2. Outer Casing Placement (For Double Cased Only)

The outer casing shall be set at least two (2) feet into competent bedrock, the confining layer or five (5) feet below the last indication of soil contamination. The casing shall then be grouted into place using a bentonite/cement grout. The grout shall consist of a mixture of Portland cement and 4%-6% powdered bentonite. A grout density of 13.5 to 14.1 lbs/gal shall be used. If water is present in the boring or the total depth of the borehole is greater than thirty (30) feet, a tremie pipe shall be used to place the grout unless the well is being installed through a hollow stem auger. The grout shall be allowed to set for a minimum of 24 hours before continuation of drilling activities.

3. Screen Length and Placement

The screen length and placement shall be such that the screen intersects the water table at all times. If the screen is placed such that ground water does not enter the well, the cost for the installation of the monitoring well may not be reimbursed from the Petroleum Underground Storage Tank Fund. Typical placement is such that seven (7) feet of screen is in the water table with three (3) feet of screen above or ten (10) feet of screen in the water table and five (5) feet of screen above. Longer screen lengths may be necessary for areas with large seasonal ground water fluctuations. A centralizer shall be used in all monitoring wells greater than twenty (20) feet in depth. The centralizer shall be placed below the screened interval at the bottom of the well.

If a confined aquifer is encountered, the water bearing section of the aquifer shall be screened.

4. Minimum Borehole Diameter

a. Single Cased

The borehole diameter shall be a minimum of four (4) inches larger than the outside diameter (O.D.) of the well casing. For example, a 2.5 inch O.D. casing would require a 6.5 inch diameter borehole. A waiver is granted in cases where a 5.5 inch O.D. or larger core barrel will be used to drill the bedrock portion of the hole.

b. Double Cased

The outer borehole diameter shall be a minimum of four (4) inches larger than the outside diameter (O.D.) of the well casing. For example, a eight (8) inch O.D. casing would require a twelve (12) inch diameter borehole. The annular space between the inner casing and the outer casing shall also be four (4) inches. A waiver is granted in cases where a 5.5 inch O.D. or larger core barrel will be used to drill the bedrock portion of the hole.

5. Placement and Type of Filter Pack

A minimum of six (6) inches of the filter pack material shall be placed under the bottom of the well screen to provide a firm footing. The filter pack shall extend two (2) feet above the top of the screened section. A weighted tape shall be used to help prevent bridging and ensure the proper placement of the filter pack. If the total depth of the borehole exceeds thirty (30) feet, a tremie pipe shall be utilized to properly place the filter pack unless the well is being installed through a hollow stem auger. The filter pack shall consist of clean, washed, well sorted silica sand. To minimize particulate infiltration in the well, the formation grain size encountered shall be considered when selecting the filter pack grain size.

6. Placement and Type of Filter Pack Seal

The filter pack seal shall be placed atop the filter pack and have a minimum thickness of two (2) feet. The filter pack seal shall consist of a high solids, pure bentonite material. A weighted tape shall be used to help prevent bridging and ensure the proper placement of the filter pack seal. If the total depth to the top of the filter pack exceeds thirty (30) feet, a tremie pipe shall be utilized to place the filter pack seal unless the well is being installed through a hollow stem auger. If the bentonite seal is placed above the water table, two (2) gallons of potable water shall be used to hydrate the pellets. The hydration time for the bentonite pellets shall be a minimum of one (1) hour.

7. Placement and Type of Annular Grout

The annular grout shall extend from the top of the filter pack seal to within two feet of the surface. The annular grout shall consist of a mixture of Portland cement and 4%-6% powdered bentonite. A grout density of 13.5 to 14.1 lbs/gal shall be used. If water is present in the boring or the depth to the filter pack seal is greater

than thirty (30) feet, a tremie pipe shall be used to place the annular grout unless the well is being installed through a hollow stem auger.

8. Surface Completion

The final two (2) feet of the annular space shall be filled with concrete terminating with a flush-mounted manhole with a watertight, bolt-down loadbearing cover unless alternate construction is approved by the Division in writing. These manholes shall be concreted in place and sloped so that surface drainage will be diverted. Above ground protective covers may be used if required by site conditions. All monitoring wells shall be clearly marked as monitoring wells and numbered.

E. Open-Hole Well Installation Procedures

Open hole monitoring wells may be used in areas where competent bedrock is encountered and geologic conditions (e.g. karst terrain) warrant their use.

In constructing an open hole monitoring well, the surface casing shall be set at least two (2) feet into competent bedrock. The surface casing shall be black steel in all cases. The casing shall be grouted into place using a bentonite/cement grout. The grout shall consist of a mixture of Portland cement and 4%-6% powdered bentonite. A grout density of 13.5 to 14.1 lbs/gal shall be used. If water is present in the boring or the total depth of the borehole is greater than thirty (30) feet, a tremie pipe shall be used to place the grout. The grout shall be allowed to set for a minimum of 24 hours before continuation of drilling activities.

Upon setting the surface casing, a borehole with a minimum diameter of three and one-half (3.5) inches shall be advanced to the desired depth.

The final two (2) feet of the annular space shall be filled with concrete terminating with a flush-mounted manhole with a watertight, bolt-down loadbearing cover unless alternate construction is approved by the Division in writing. These manholes shall be concreted in place and sloped so that surface drainage will be diverted. A locking, watertight cap shall be used. All monitoring wells shall be clearly marked as monitoring wells and numbered.

F. Well Development

Monitoring well development shall not begin until a minimum of 24 hours following completion of the well and shall continue until such time as the water column is free of visible sediment. Should development procedures not produce a water column that is sediment free, development shall continue until pH, specific conductance, and temperature have stabilized.

The following methods shall be used individually or in combination for well development:

1. Bailing
2. Pumping
3. Surging

G. Surveying

A survey shall be performed to obtain the following information:

1. The elevation of the established and documented point on the top of each well casing correlated with a mean sea level datum, if available.

2. The distance and angle from monitoring well four (MW-4) to the established and documented point on the top of each well casing shall be measured. All angles shall be measured from magnetic north. This data shall be used to establish the monitoring well location map.

H. Water Level Measurements

All water level measurements, shall be referenced from the established and documented point on the top of the well casing. Measurements shall be to the nearest 0.01 foot.

Static water levels shall be measured using an electronic water level indicator. Measurements shall be taken no sooner than 24 hours after completion of well development, but prior to purging. Static water level measurements shall be taken prior to each sampling event.

If free product is encountered during water level measurements, the thickness of the free product shall be measured to the nearest 0.01 foot.

I. Ground Water Sampling

All ground water monitoring wells shall be sampled unless 0.01 foot or more of free product is encountered. All monitoring well sampling shall follow the protocol as described below.

1. Purging

After determining the static water level of the well, but prior to collecting a sample, the total volume of water in the well shall be calculated. A minimum of three (3) well volumes shall then be purged from the well. If the well is purged to dryness before three (3) well volumes are obtained, no further purging shall be required. The samples shall then be collected as soon as a sufficient volume of ground water recharges into the well.

2. Sample Containers and Preservation

All sample containers shall be pre-cleaned and sealed by the distributor or laboratory. Each sample bottle shall be properly preserved prior to sample collection in accordance with Table 4 below.

TABLE 4

Sample Containers and Preservatives		
Parameter	Container	Preservative
Volatile Organics	40 ml amber glass vial with Teflon lined septa	four (4) drops of 1:1 hydrochloric acid
TPH, Gasoline Range Organics	40 ml amber glass vial with Teflon lined septa	200 uL of 50% hydrochloric acid
TPH, Diesel Range Organics	1 liter amber glass bottle with Teflon lined lid	five (5) ml of 1:1 hydrochloric acid

3. Collection Method

All samples from ground water monitoring wells shall be collected with a new, disposable bailer. In order to keep agitation of the sample to a minimum, the bailer shall be slowly lowered into the water column. When transferring the sample from the bailer to the sample container, care shall be taken to minimize agitation. When collecting volatile organic samples, the sample container shall be completely filled so that air bubbles are not trapped inside. Care shall also be taken to have minimal overflow so that the preservative is not lost.

Upon collection, samples shall be immediately labeled, placed in a cooler and chilled to approximately $4^{o}C$. The samples shall be maintained at $4^{o}C$ until they are delivered to a state approved laboratory.

No sampling equipment shall be placed directly on the ground or other possibly contaminated surface prior to insertion into a well. A clean plastic sheet or other appropriate material shall be placed by each well for all sampling equipment.

J. Disposal of Purge and Development Water

All purge and development water shall be managed in a manner such that these materials will not cause pollution and disposal is in accordance with all applicable State and Federal Laws.

K. Analytical Methods

When analyzing water samples for Volatile Organics, the approved laboratory shall use Test Methods for Evaluating Solid Waste (SW-846). At a minimum, the following constituents shall be analyzed: benzene, toluene, xylenes, ethylbenzene, MTBE as follows:

1. The purge and trap procedures for the water samples in Method 5030 shall be performed; then

2. The actual constituent analysis shall be performed using gas chromatography with a photoionization detector following method 8020.

The practical quantitation limit for any individual constituent using this method is 0.002 PPM for ground water samples. All results shall be reported in PPM.

There are three (3) methods for TPH that are used depending on the type of petroleum involved. A review of the type of petroleum stored at the site shall be performed to determine which analytical method or methods shall be used for TPH analysis. Refer to Table 5 below for assistance:

TABLE 5

TPH SOIL ANALYTICAL METHODS		
Boiling Point	Quantitation Limit	Method
1. Between 70^{O}-180^{O}F (e.g. gasoline)	0.1 PPM	Gasoline Range Organics (GRO)
2. Between 180^{O}-450^{O}F (e.g. diesel, kerosene)	0.1 PPM	Diesel Range Organics (DRO)
3. Greater than 450^{O}F (e.g. used oil)	1.0 PPM	Method 503 E or Method 418.1

If a waste oil UST is in the same tank pit as the gasoline and/or diesel UST's at a site, then an appropriate combination of analytical methods shall be required. If samples must be analyzed using both the Gasoline Range Organics Method (GRO) and The Diesel Range Organics Method (DRO), then the results of each analysis shall be summed (GRO + DRO) and reported as Total Petroleum Hydrocarbons (TPH).

In those situations where the type of hydrocarbon stored is unknown or both gasoline and diesel products were stored, the samples shall be analyzed using both the Gasoline Range Organics Method and the Diesel Range Organic Method with the results summed to determine the TPH level.

L. Ground Water Classification Procedure

The following steps shall be performed, **IN SEQUENCE**, to determine if the ground water at a site should be classified as either a drinking water supply or a non-drinking water supply. If at any point during the classification procedure the aquifer or water supply is classified as a drinking water supply, then no further steps shall be completed. Refer to Table 6 below, to determine the applicable cleanup levels based upon the Ground Water Classification.

1. Water Use Survey

Perform a water use survey within a one-half (0.5) mile radius of the UST site. The following actions shall take place at a minimum:

a. Personally contact, by phone or in person, all water users within a one-tenth (0.1) mile radius of the site and complete the appropriate Water Use Survey Form. These forms (private supply and municipal supply) are attached with this document;

b. Perform a field survey within a one-quarter (0.25) mile radius of the UST site to determine the existence of any water use supplies. If a drinking water supply is identified, then the user shall be personally contacted and a Water Use Survey Form completed for each water supply identified; and

c. Perform a records search within a one-half (0.5) mile radius of the UST site to determine the existence of any water use supplies. If a drinking water supply is identified, then the user shall be personally contacted and a Water Use Survey Form completed for each water supply identified.

If any aquifer or water source is being used by the citizens of the state, then the aquifer or water source shall be classified as a drinking water supply.

If any drinking water supply (well or spring) is found within a one-half (0.5) mile radius of the UST site, justification may be provided describing why the water supply should not be used in classifying the impacted aquifer or water source as a drinking water supply. The justification shall include, but not be limited to, the direction of ground water flow and the hydrogeologic characteristics (i.e. hydrologic boundaries).

2. Analytical Sampling

Determine if the impacted aquifer or water source meets the primary and secondary drinking water standards of Rule 1200-5-1, by analyzing the water from a well which has not been impacted by petroleum contamination, if one exists. If an unaffected well does not exist then the well with the lowest contamination shall be used. The sample shall be analyzed for Iron and Manganese only. If the analytical results indicate that the levels are below the established secondary standard for both parameters, a second sample shall be collected and analyzed for the remaining primary and secondary standards.

If the impacted aquifer or water source fails to meet any of the primary or secondary standards and is not a drinking water supply as determined in the water use survey, it may be classified as a non-drinking water supply. However, failure of the aquifer or water source to meet the primary or secondary standards cannot be the result of petroleum contamination, unless naturally occurring. A list of the primary or secondary drinking water standards can be found in TGD - 002, Division of Water Supply- Primary and Secondary Drinking Water Standards.

3. Pump Test

If the ground water meets the criteria of the primary and secondary Drinking Water Standards, then the yield of the aquifer or water supply shall be determined. A suitable pump test method shall be used to determine if the impacted aquifer or water source is capable of providing a yield of at least one-half (0.5) gallon per minute. The monitoring well considered to have the highest yield shall be the first well pump tested. If this first well does not yield at least one-half (0.5) gallon per minute, all additional monitoring wells shall be pump tested until either all wells have been tested or one well yields at least one-half (0.5) gallon per minute. If the impacted aquifer or water source is not able to produce water at the rate of one-half (0.5) gallon per minute and is not a drinking water supply (as determined in the water use survey), it may be classified as a non-drinking water supply.

TABLE 6

GROUND WATER CLEANUP LEVELS (PPM)		
	Benzene	TPH
Drinking Water	0.005	0.1
Non-Drinking Water	0.070	1.0

M. Decontamination Procedures

Drill rigs and other equipment shall be inspected for lubricant or fluid leaks which could be potential contaminant sources. All over-the-hole portions of the drilling equipment shall be steam cleaned prior to use and as necessary between boring locations. All down hole equipment (i.e. augers, drill rods, tools, etc.) shall be steam cleaned prior to use and between all subsequent borings.

All sampling equipment which is not pre-cleaned and disposable and all monitoring equipment shall be properly decontaminated before each use by the following procedure:

1. Cleaned with a laboratory grade detergent wash;

2. Triple rinsed with distilled water; and

3. Allowed to air dry.

All black steel well casing to be used in well construction shall be decontaminated by steam cleaning prior to use.

N. Monitoring Well Abandonment Procedures

Upon completion of site investigations and/or corrective actions and as directed by the Division, all monitoring wells shall be properly abandoned. Proper abandonment procedures are as follows:

1. For wells with risers, the casing shall be cut off at ground level.

2. The monitoring well casing shall be filled from bottom to top with a grout mixture consisting of Portland cement and 4%-6% powdered bentonite. A grout density of 13.5 to 14.1 lbs/gal shall be used. The grout shall be placed using a tremie pipe.

III. QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

The following procedures shall be followed for QA/QC:

A. Before each use, all equipment which is not pre-cleaned and disposable shall be properly decontaminated.

B. Sampling personnel shall wear new, disposable sampling gloves while collecting all samples. Gloves shall be changed between each sampling point.

C. Sampling containers shall be laboratory prepared glass jars, glass bottles or vials (i.e. meet analytical method requirements).

D. All samples shall be immediately placed in the appropriate containers in a manner to minimize headspace.

E. All samples collected for potential laboratory analyses shall be properly labeled and stored at $4^{o}C$ or less.

F. Each jar shall be sealed separately in an airtight container (sealing plastic bag).

G. A chain of custody form shall be completed for each soil and ground water sampling event. This form shall be signed by the person collecting the sample, the laboratory receiving the sample(s), and all intermediary persons with possession of the sample. Sample security shall be maintained during all phases of transport.

H. Sampling shall begin at the location where contamination is least likely to exist (background) and end at the location where the highest levels of contamination are most likely to exist (near the release).

I. All field instruments shall be calibrated daily and the calibration records maintained.

J. When sampling monitoring wells, one (1) duplicate sample shall be collected during each sampling event.

IV. SITE SAFETY PLAN

A Site Safety Plan shall be developed and kept on site at all times work is being performed. It shall be written to avoid misinterpretation. All personnel shall be familiar with all information contained in the Site Safety Plan. All personnel on site shall sign the Site Safety Plan. At a minimum the plan shall contain the following:

A. Description of Known Hazards and Risks

This shall include all known or suspected physical and chemical hazards. It is important that all health related data be kept up-to-date. As air, water, soil, or hazardous substance monitoring and sampling data becomes available, it shall be evaluated, significant risk or exposure to workers noted, potential impact on the public assessed, and changes made in the plan. These evaluations need to be repeated frequently since much of the plan is based on this information.

B. Designation of Key Personnel and Alternatives

The plan shall identify the incident manager, as well as the site safety and health officer (and alternate) and any other personnel responsible for the site safety. It shall also identify key personnel assigned to various site operations.

C. Designation of the Levels of Protection

The Levels of Protection to be worn at the locations on-site or by work functions shall be designated. This includes the specific types of respirators and type of chemical protective clothing to be worn for each level. No one shall be permitted in the areas requiring personnel protective equipment unless they have been trained in its use and are wearing it.

D. Delineation of the Work Area

Work areas need to be designated on the site map and the map posted. The size of the zone, the zone boundaries, and access control points into the zone shall be marked and made known to all site workers.

E. Description of Control Procedures

Control procedures shall be implemented to prevent unauthorized access. Procedures shall be established to control authorized personnel entering work zones where personnel protection is required.

F. Requirements for an Environmental Surveillance Program

A program to monitor site hazards shall be implemented. This shall include air monitoring and sampling, other types of media sampling at or around the site that shall identify chemicals present, their hazards, possible routes of migration off-site, and associated safety requirements.

G. Requirements for Routine of Special Training

Personnel shall be trained not only in general safety procedures and use of safety equipment, but in any special work they may be expected to do.

H. Procedures for Weather-Related Problems

Weather conditions can affect site work. Temperature extremes, high winds, storms, etc. impact personnel safety. Work practices shall be established to protect workers from the effects of weather and shelters provided, when necessary. Temperature extremes, especially heat and its effect on people wearing protective clothing, shall be considered and procedures established to monitor for and minimize heat stress.

I. Determination of Site Specific Medical Requirements

Specialized medical requirements due to unusual hazards expected or known to be encountered shall be determined.

J. On-site Emergencies

The plan shall address site emergencies - occurrences that require immediate actions to prevent additional problems or harm to responders, the public, property, or the environment. Unpredictable events such as fire, chemical exposure, or physical injury may occur and shall be anticipated. The plan shall contain detailed information for managing these contingencies.

To accomplish this, the contingency plan shall:

1. Establish site emergency procedures

a. List the names and emergency functions of on-site personnel responsible for emergency actions along with the special training required.

b. Post the location of the nearest telephone (if none are present on the site).

c. Provide alternative means for emergency communications.

d. Provide a list of emergency services organizations that may be needed. Names, telephone numbers, and locations shall be posted. Arrangements for using emergency organizations may need to be made beforehand. Organizations that might be needed are:

i. Fire and Rescue Agency

ii. Police Department

iii. Local hazardous material response units

iv. Emergency Services Offices

e. Address and define procedures for the rapid evacuation of workers. Clear, audible warning signals shall be established. Well-marked emergency exits shall be located throughout the site. Internal and external communications plans shall be developed.

f. A complete list of emergency equipment shall be attached to the safety plan. This list shall include emergency equipment available on-site, as well as all available medical, rescue, transport, fire-fighting, and mitigating equipment available off-site.

2. Address emergency medical care

a. Determine the location of the nearest hospital or emergency care facility and determine their capability to handle chemical exposure cases.

b. Post the location of medical or emergency care facilities, travel time, directions, and telephone numbers.

c. Determine nearest ambulance service and post the telephone number.

d. Maintain accurate records of any exposure or potential exposure of site workers during an emergency (or routine operations).

e. Advise workers of their duties during an emergency. In particular, it is imperative that the site safety officers practice emergency procedures.

f. Establish procedures, in cooperation with local and state officials if appropriate, for evacuating residents who live or work near the site.